Custom-Built Electric Bike

Battery System

The battery was built using 39 Panasonic cells, each with a capacity of 11.5 Wh and a continuous discharge rating of 10A. The cells are arranged in a 13s3p configuration, resulting in a 48.1V, 30A, 448.5 Wh pack.

To ensure safety, I integrated a 13s Battery Management System (BMS) that monitors cell balance and protects against overcharge/discharge. The cells are spot welded with nickel strips using a custom-built spot welder. A digital voltage gauge is mounted on top for quick charge level indication.

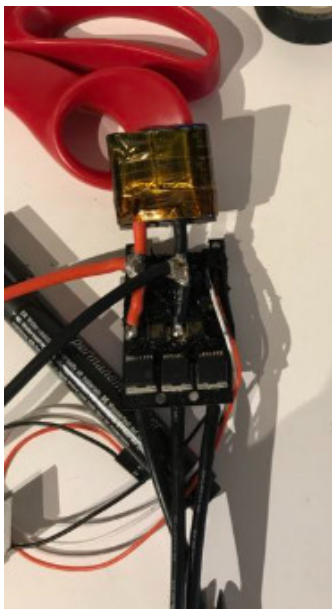
The battery enclosure was designed in Autodesk Inventor and 3D printed in PETG using a support-free geometry. The design features:

- A textured "fuzzy skin" finish for grip and visual consistency
- A visual indent ring for intuitive orientation
- A mounting system, allowing quick removal while maintaining a clean aesthetic

Controller

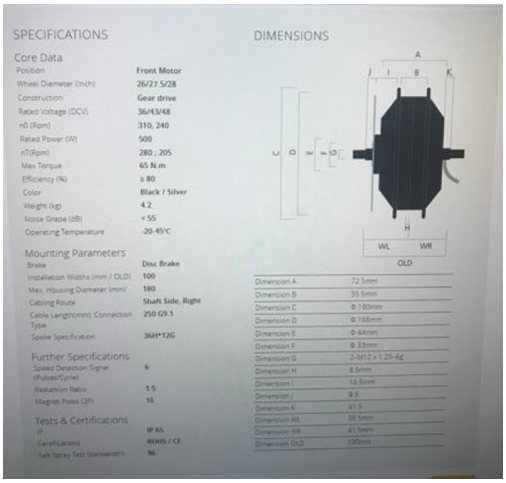
The motor controller is a Flipsky programmable VESC capable of handling 8–60V and delivering up to 14,400W. Its compact form factor allowed me to mount it discreetly beneath the bike frame, hidden behind the crank.

The casing is an aluminum extrusion with custom 3D-printed end caps, sealed with a clear O-ring for waterproofing. Two M4 bolts compress the seal, ensuring weather resistance. The aluminum not only provides structural integrity but also aids in heat dissipation. For a uniform look, the enclosure is wrapped in black electrical tape.



Motor

I selected a Bafang hub motor, known for its efficiency and durability. It delivers 500W continuous power with high-torque gearing, optimized for hill climbing. As a rear hub motor, it integrates seamlessly into the wheel and includes a freewheel mechanism that offers low resistance when unpowered, preserving the feel of a traditional bike.

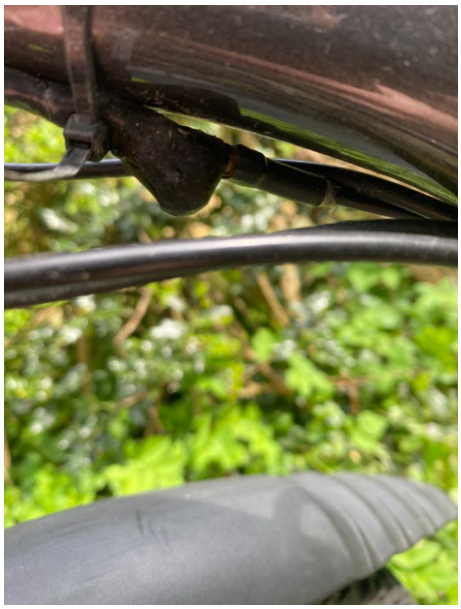


Lighting System

Both front and rear lights were custom built:

- The front light is a modified flashlight mounted in a 3D-printed housing.
- The rear light features a red LED filament encased in UV resin, with a 3D-printed bracket mounted using zip ties.

Both lights are powered directly from the main battery and activated via a silicone-encapsulated on/off switch near the handlebar, ensuring waterproof operation and ease of use.



Rider control experience

The throttle and pedal assist system is controlled via a potentiometer-based input, allowing the rider to smoothly adjust the motor assistance and turn on the throttle. I designed a 3D-printed cap for the potentiometer with a conical, grooved surface for enhanced grip and thumb comfort.

- Circle: Potentiometer
- Triangle: Clock display
- Square: Throttle

Skills Demonstrated

- CAD design (Autodesk Inventor)
- Battery pack assembly and BMS integration
- Electrical waterproofing techniques
- 3D printing for functional mechanical parts
- DIY lighting and wiring
- Soldering
- Power electronics (motor control systems)